A Snapshot of the Use of ICT in Primary Mathematics Classrooms in Western Australia

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Lorraine Day reports on some of the findings of the Teaching Teachers for the Future Project. The Australian Curriculum constantly makes reference to digital technologies so we believe our readers will be interested to see how teachers are making use of technology in classrooms across Western Australia. The results may be used to 'benchmark' what is going on in your school.

Introduction

The Teaching Teachers for the Future (TTF) Project aims to build the capacity of pre-service teachers to achieve and demonstrate competence in the effective and innovative use of information and communication technologies (ICT) in education to improve student learning. The project was funded by the Australian Government Department of Education, Employment and Workplace Relations (DEEWR) through the ICT Innovation Fund. At The University of Notre Dame Australia the focus of the TTF Project was on the *Australian Curriculum: Mathematics* within the Bachelor of Education (Primary). An understanding of the current availability and use of ICT in primary mathematics classrooms in Western Australia was a local research component intended to complement and inform the TTF Project.

To determine the types of ICT being used in mathematics classrooms in WA primary schools, a short survey was devised and sent electronically to a random selection of principals of primary schools in Western Australia, including metropolitan, rural and remote schools. The 118 schools which responded to the survey were representative of the Government, Independent and Catholic systems and sectors. In addition, 116 final year pre-service teachers were surveyed about the types of technology they had used in mathematics classrooms during their internship. This article examines the use of ICT in mathematics classrooms from the two perspectives.

Methodology

A qualitative online survey consisting of eight questions regarding ICT use in mathematics classrooms was sent to principals at 400 randomly selected primary schools in Western Australia. One hundred and eighteen responses were received which constitutes a response rate of 29.5%. Of these responses, 32 (26%) were from Government schools, 36 (31%) from Independent schools and 50 (43%) from Catholic schools. The questions addressed how often ICT is used during mathematics lessons, how students are able to access computers, the software utilised in mathematics lessons, and what were considered to be the best ICT resources used in the teaching of mathematics. Other questions sought information about the role of ICT in developing mathematical concepts, the role of ICT in simulating real world, authentic contexts and the ICT skills that principals believed were important for beginning teachers. The data from these surveys were collated and described.

On return to university for their mid-internship briefing, 116 final-year pre-service teachers (PST) completed a survey about ICT usage in mathematics classrooms during their final practicum (internship). The students were asked how often ICT was used in mathematics teaching, how the children were able to access ICT and which software resources were used in teaching mathematics classes. The pre-service teachers were completing their internships in a variety of Government, Independent and Catholic schools. The response rate was 100% of those who attended the briefing. These data were collated and described separately. They are reported together with the data from the principals to allow comparisons to be made.

Results and discussion

When school principals were asked how frequently ICT was used in mathematics teaching, 94% indicated that ICT was used regularly or occasionally. Two percent indicated that ICT was never used and the explanation from these schools was that they were schools (such as Steiner schools) which had made a decision not to utilise ICT in the primary years. The results from the pre-service teacher survey painted a different picture, with 73% indicating that ICT was used regularly or occasionally in mathematics classrooms and 27% who reported they were utilised rarely or never (see Figures 1(a) and 1(b) below).

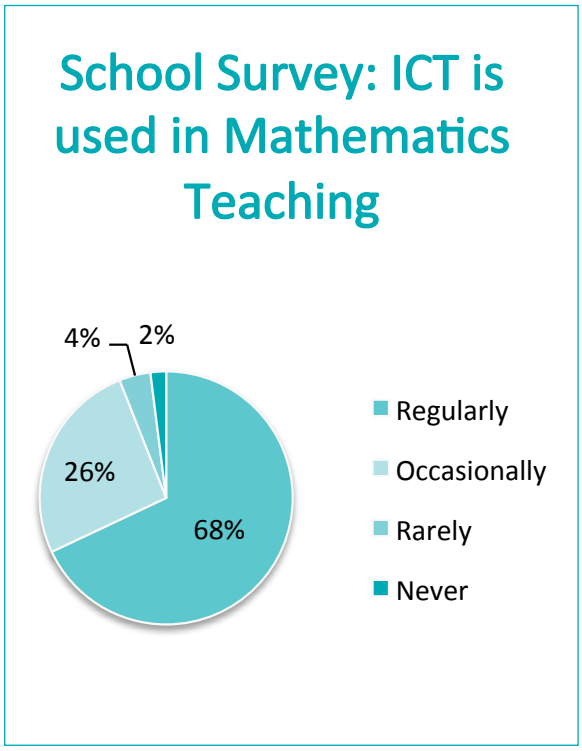

Figure 1(a)

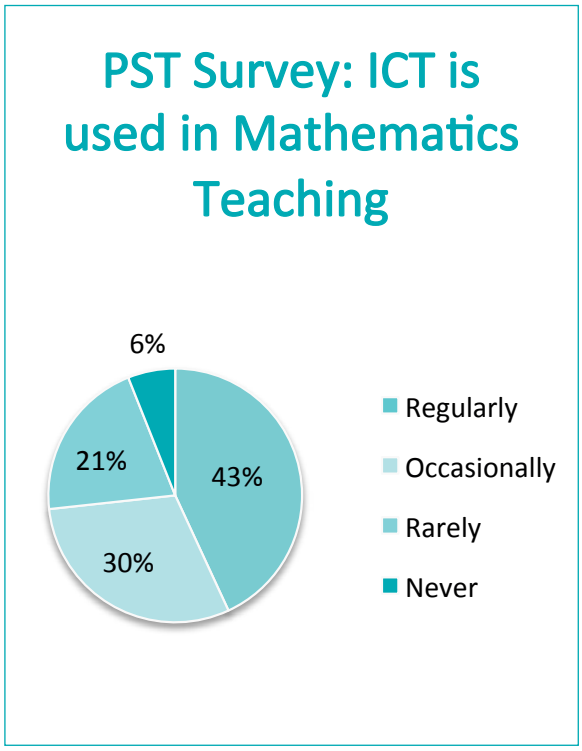

Figure 1(b)

The principals and the pre-service teachers appeared to view situations differently. There may be several reasons for this: ICT may have been used more regularly in other subject areas than mathematics teaching and the general use of ICT is what was being reported; mentor teachers may have changed their methods when they had a pre-service teacher with them; the principals may have had expectations that were not being realised in the classrooms; or the pre-service teachers may have interpreted the terms 'regularly,' 'occasionally' and 'rarely' differently to principals, who had probably watched the growth of use of ICT over a period of time.

When asked how students were able to access ICT, there were no responses from either survey that indicated "no computer access". From the results, it would appear that primary schools have had embraced the interactive whiteboard (IWB) technology. The principals were reporting on their entire primary school and the pre-service teachers were referring to a single classroom. This may account for the differences between the data displayed in Figures 2(a) and 2(b).

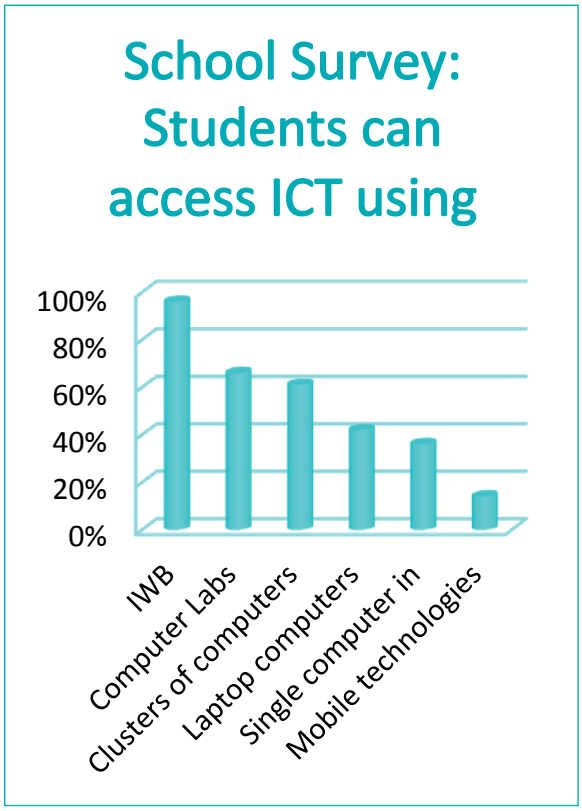

Figure 2(a)

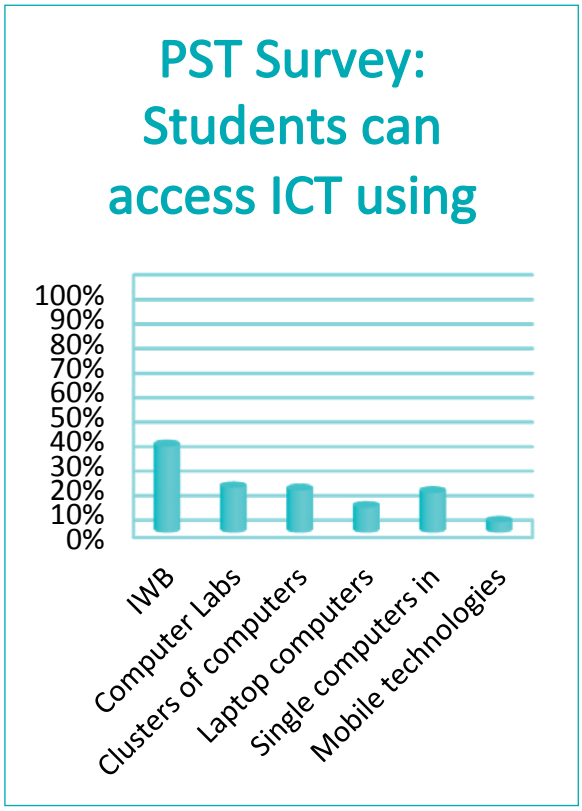

Figure 2(b)

Some of the uses of ICT in mathematics classrooms included: drill and practice programs or games; tutorial software that showed students how to work through procedures; as a source of feedback on responses; software specifically written for mathematics classrooms that provided opportunities for students to participate in mathematics, simulate contexts and problem solving; and general software such as word processors, spreadsheets, presentation software and the Internet (Kissane, 2011; Reynolds, Treharne & Tripp, 2003; Samuelsson, 2007). Interactive whiteboards (IWB) and their accompanying software, which are embraced by primary teachers, are often used for motivational purposes to introduce topics (Zevenbergen & Lerman, 2007). Mobile technologies, also, are beginning to be seen in classrooms. They are reasonably cheap, easy to carry around and students relate to them well (Allen, 2011).

Many authors (Kennewell & Beauchamp, 2007; Serow & Callingham, 2008; Smith, Hardman & Higgins, 2006; Zevenbergen & Lerman, 2007) express concern about how IWBs are used in mathematics classrooms. Although teachers have embraced the IWB

technology, there is a lack of evidence to support the contention that their use enhances the development of deep mathematical understanding (Kennewell & Beauchamp, 2007; Zevenbergen & Lerman, 2007). Armstrong et al. (2005) believe that teachers need more professional development in how they can best utilise the IWB technology in the mathematics classroom. They point out there is little doubt that IWBs have the potential to enrich the mathematical learning experiences for children, especially when their use has mathematical content and pedagogical considerations at the centre of the planning of why, when and how to use them (Kent, 2006; Serow & Callingham, 2008; Zevenbergen & Lerman, 2007). An investigation of the way in which IWBs are being used in mathematics classrooms would be a worthwhile further study.

The next section of the data collected related to the types of software and Internet resources being used in mathematics classes. The survey listed 10 resources (see Figure 4(a)) from which the principals could choose and then they had the option to list any other resources which were being used in mathematics classrooms. Figure 3 shows the results from choosing from the listed resources and Figure 4 displays the results which were listed in the other resources used. The school surveys indicated that by far the most common resources used were the Internet and IWB software, closely followed by *Mathletics*. Interestingly, resources specifically developed to aid the development of mathematical concepts, such as the Learning Federation's *Learning Objects*, *Maths300*, *Geogebra*, *TinkerPlots*, *Autograph*, the *Illuminations* website and the *National Library of Virtual Manipulatives* were far less likely to be reported as being used in mathematics classrooms.

As can be seen in Figure 3, Internet resources were being widely utilised in mathematics classrooms. There are many to choose from and they are easy to access, convenient and quite often free. As there are so many web-based resources available, the challenge for teachers is being able to discern which resources are the most suitable and promote the development of mathematical concepts (Fitzallen, 2007). In their research Handal, Handal and Herrington (2006) found that many of the mathematical learning objects

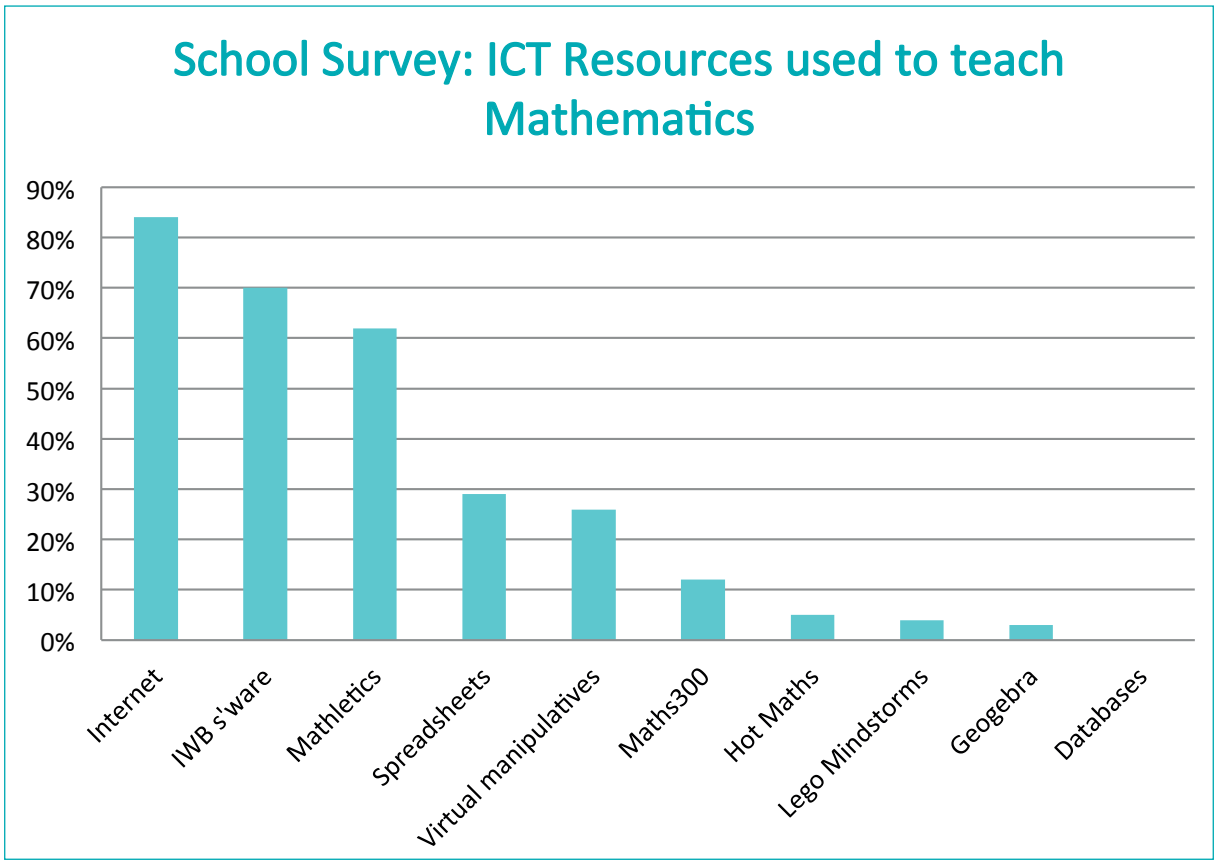

Figure 3

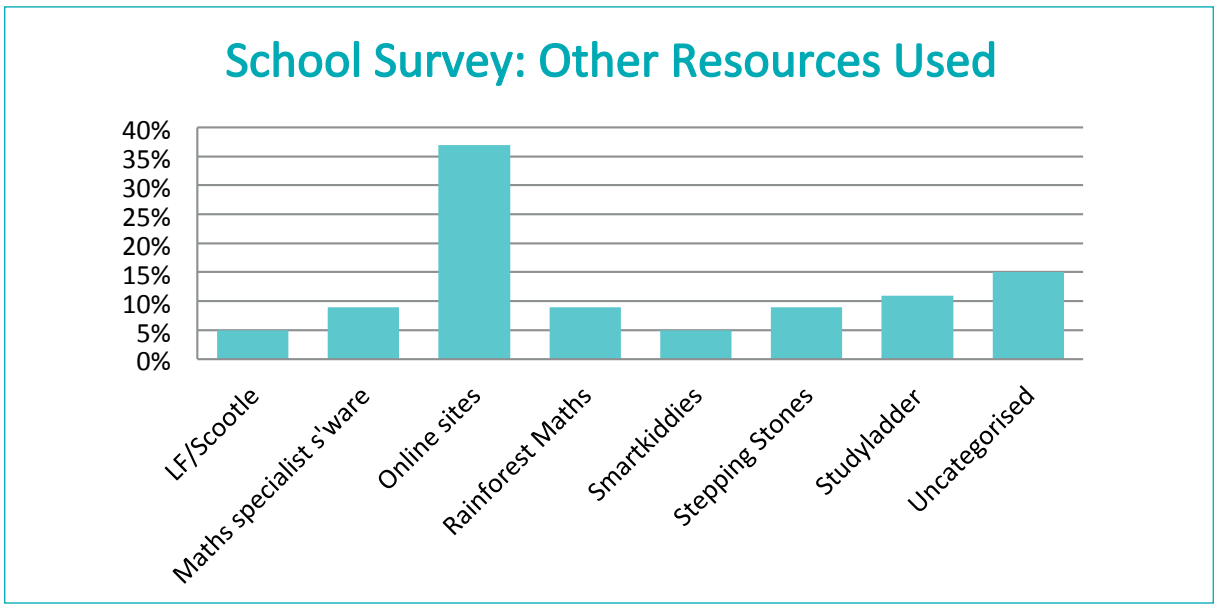

Figure 4

available on the Internet lack appropriate pedagogical underpinning. They go on to suggest that, in general, online resources produced by professional organisations tend to be better designed for use in the classroom.

In Figure 4, *Autograph*, *The Geometer's Sketchpad* and *TinkerPlots* were grouped together as "Maths specialist software" section.

To simplify the data collection, the pre-service teachers were provided with an extensive list of 26 resources (built from the list from the school survey) from which to choose and were also provided the option of listing any other resources that were used in their classes. *Mathletics* was the most common resource used, with 56% of the pre-service teachers saying it was used in their classes. IWB software was also commonly used in their classes. The Maths Specialist Software category was a combination of *Maths300*, *Geogebra* and *TinkerPlots* which were the only software packages of this type mentioned (see Figure 5).

Once again, it can be seen that practice and tutoring-type resources such as *Mathletics*, along with IWB software, are used often in mathematics classes, whereas resources

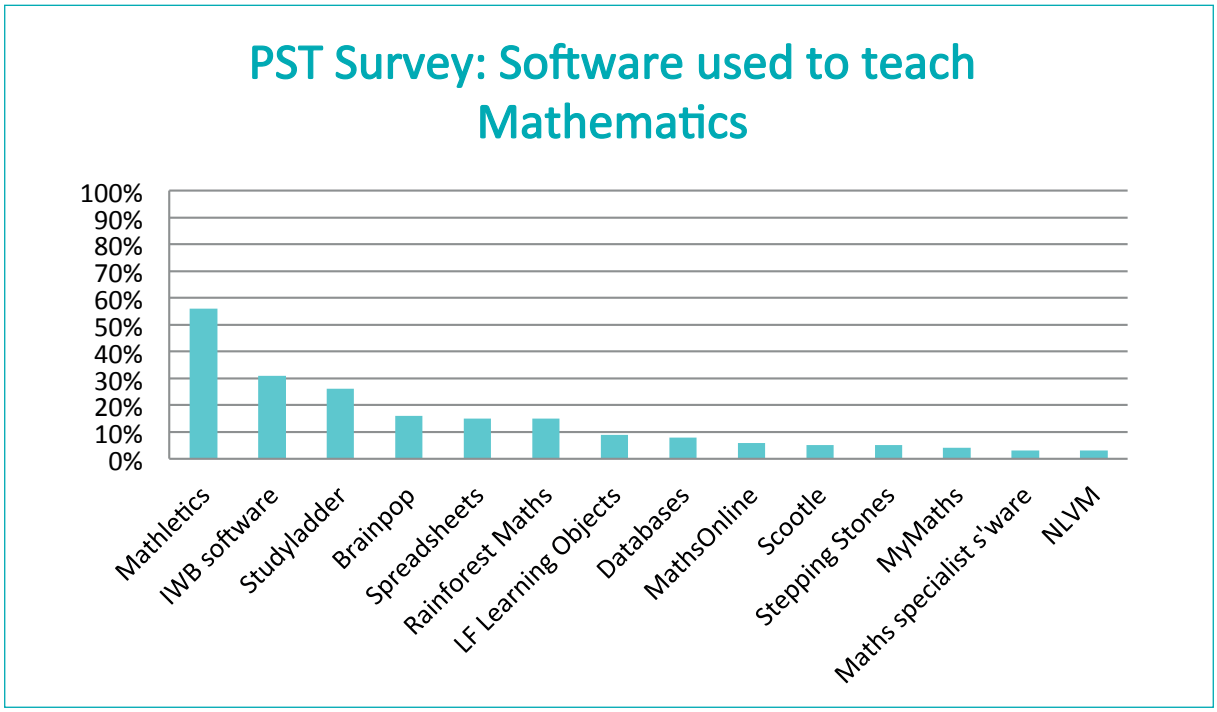

Figure 5

which are specifically designed to develop mathematical concepts were utilised less frequently. It may be that teachers were unaware of the potential or availability of these resources, or that some required a subscription or licence for a fee. There is also a financial consideration when purchasing licences for *Mathletics*, though many schools passed this cost on to parents. In their analysis of ICT project grant applications in Australia, Way and Webb (2007) saw a trend of schools moving from thinking about ICT as resources for practice and skill development towards higher-level mathematical concept development. This does not appear to be supported by the data collected in these surveys. This is interesting, as when principals were asked what role, if any, ICT had in developing student understanding of mathematical concepts, 40% responded that concept development was very important. A quarter of principals saw ICT role as a vehicle for practice of skills and 24% believed the use of ICT was a good motivator (see Figure 6).

The introduction of ICT into mathematics classes does not necessarily lead to an increase in mathematical understanding and concept development. It is how teachers choose to use ICT, their beliefs about how children best learn mathematics, and whether ICT is used for instructional purposes or to assist in developing deep mathematical understanding, which determine the effectiveness of the integration of ICT (Anderson, 2009; Bate, 2010; Bos, 2009; Highfield & Goodwin, 2008; Jonassen, Carr & Yueh, 1998; Zevenbergen & Lerman, 2007).

Although using real life simulations were seen by relatively few as a role ICT play in developing student understanding of mathematical concepts, when principals were asked specifically whether ICT have a role in simulating authentic activities, 74% responded that they do. Ten percent stated that there was potential that was not, as yet, being realised in mathematics classrooms (see Figure 7).

School principals were asked to comment on what they believed were the best ICT resources used in their schools to teach mathematics and multiple responses were acceptable (see Figure 8). Once again the

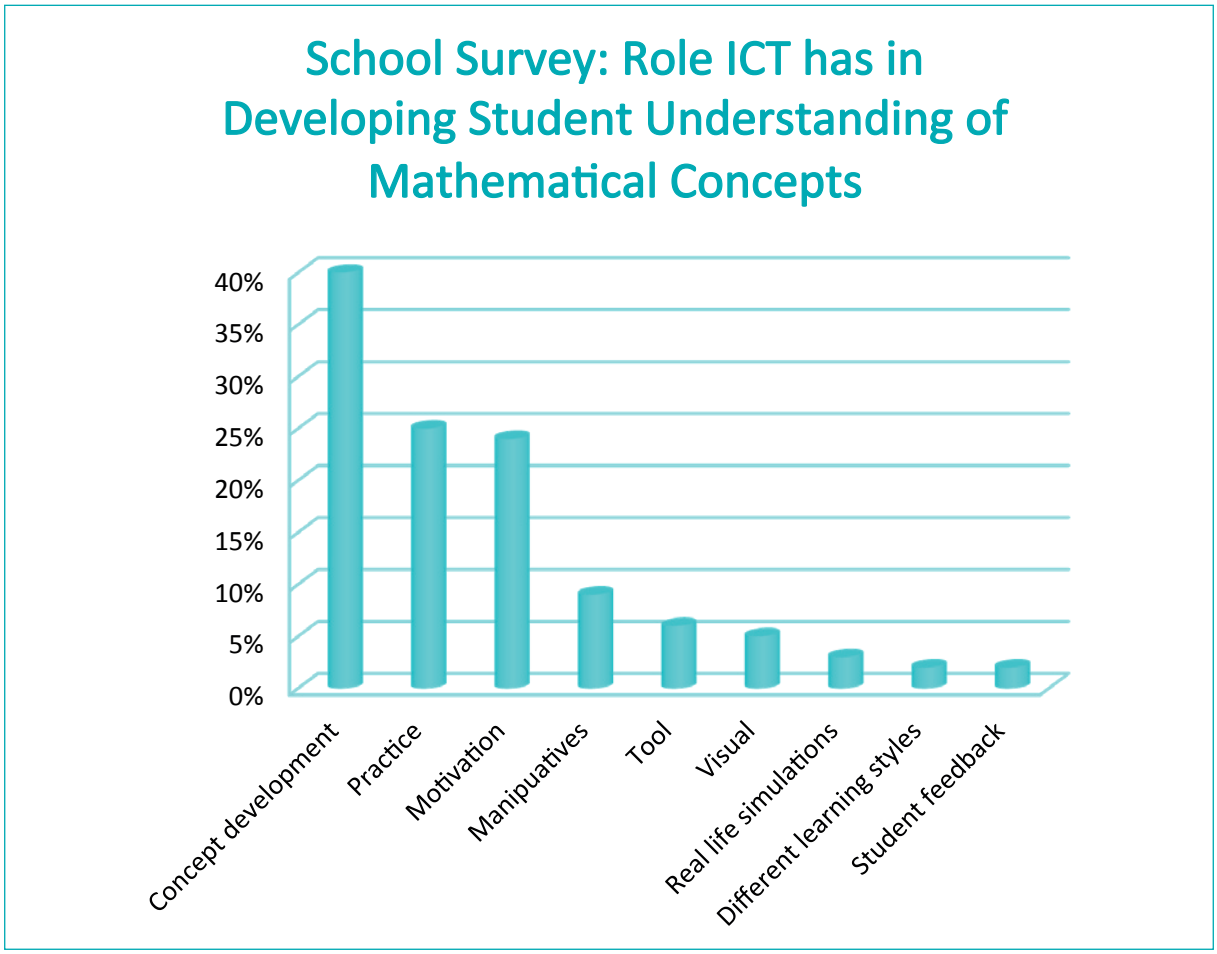

Figure 6

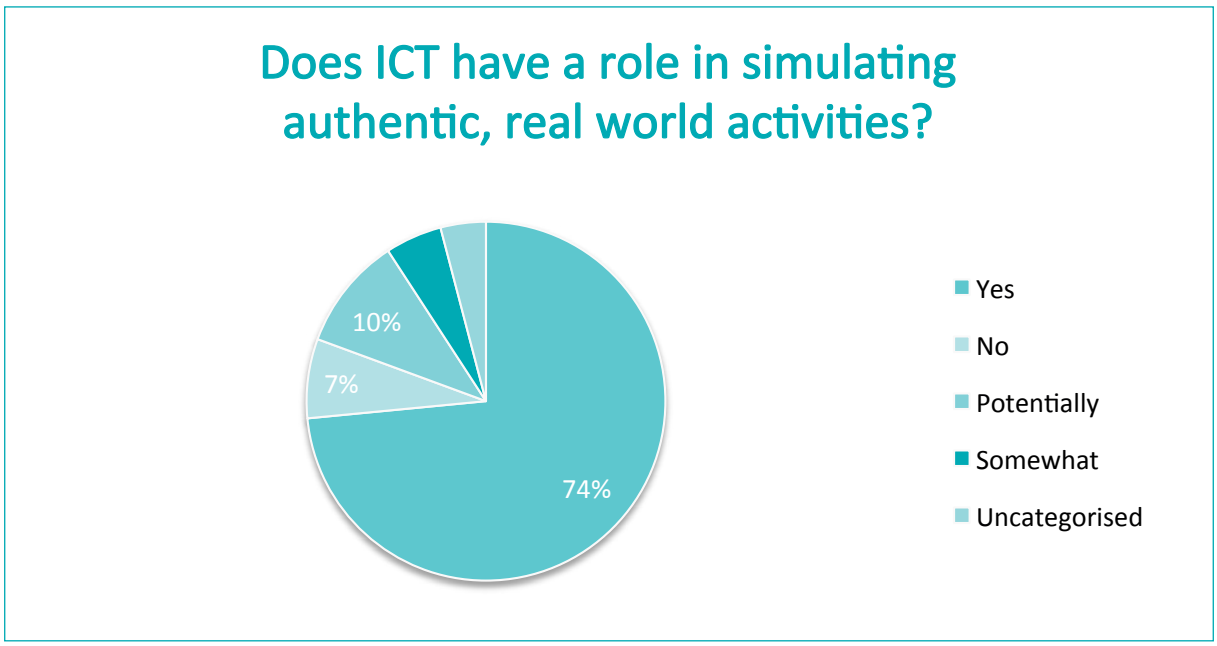

Figure 7

IWB software, resources from the Internet and *Mathletics* were represented highly. The Maths specific software grouping was made up of *Autograph*, *Maths300*, *Geogebra*, *TinkerPlots*, *National Library of Virtual Manipulatives* and *The Geometer's Sketchpad*.

The final aspect of the survey sent to schools was an open-ended question about what principals believed were the important ICT skills that beginning teachers should possess. Unsurprisingly given the previous data, most principals indicated that beginning teachers should be familiar with using IWBs, the Internet and the suite of Microsoft Office programs. The principals also valued beginning teachers who demonstrated a willingness to learn and the confidence to try new things. Along with this there was a hope that graduates would be familiar with the resources that were available and relevant, and could discern between quality resources and others. The pedagogical aspects of using ICT were also viewed as important by 15% of those who responded (see Figure 9).

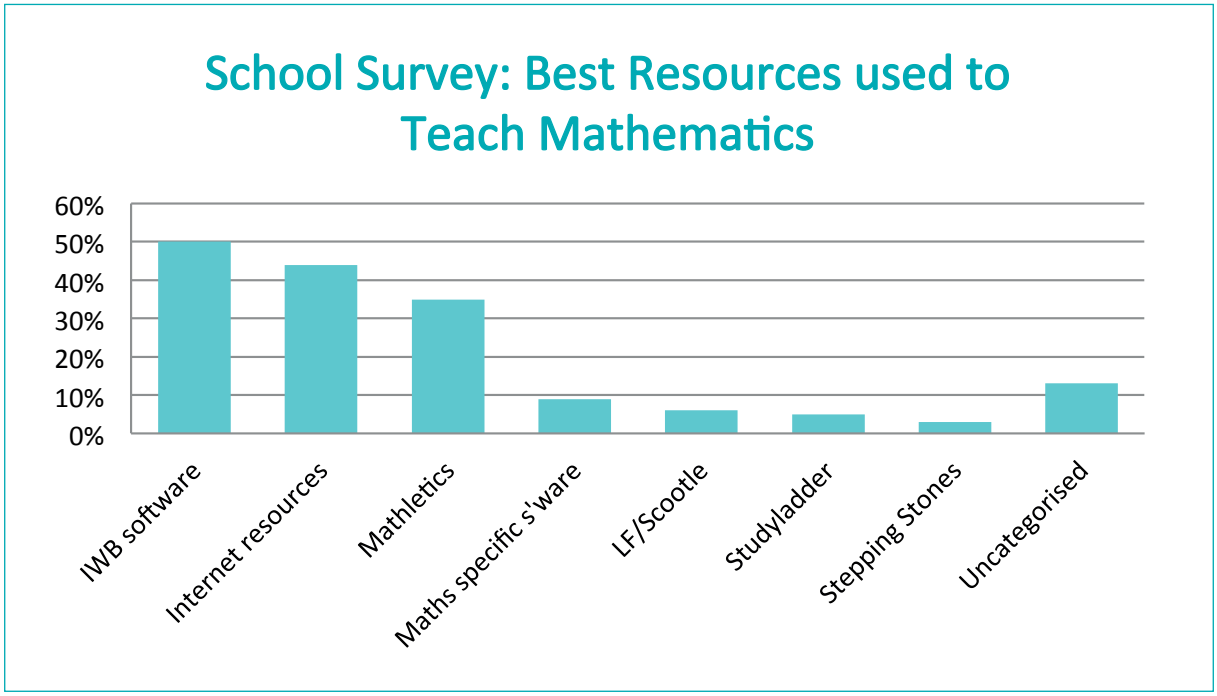

Figure 8

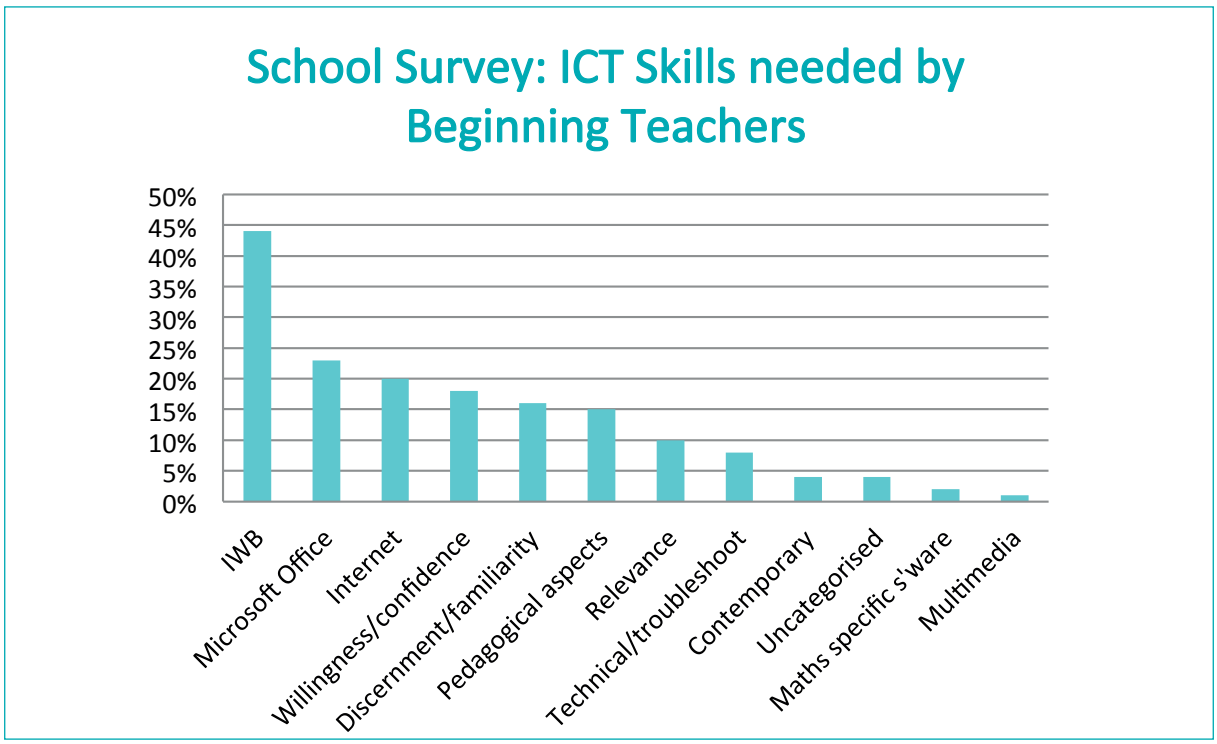

Figure 9

Conclusion

This data does not provide information about how these resources were being used in the teaching of mathematics, but it provides a snapshot of current usage of ICT in classrooms from the perspectives of school principals and pre-service teachers. However, some general comments about teaching practices using ICT can be gleaned from the types of resources being utilised in schools. Another study to investigate further the issues raised in this paper may provide more clarity about how the resources are being used in mathematics classes. Even though past research has indicated how the use of ICT could best be used to assist in mathematical concept development, the data shows that teachers are still not utilising dedicated mathematical software to assist students to develop understanding of mathematical concepts. The emphasis appears to be on the use of drill and practice applications. It appears there exists an opportunity for teachers to become aware of the potential of integrating quality mathematical software that encourages student understanding of mathematical concepts within meaningful contexts.

Traditionally, ICT has been used to provide feedback and reinforcement, drill and practice activities and games for early finishers (Bate, 2010; Scott, Downton, Gronn & Staples, 2008). Bottino (2004) reported that the introduction of ICT into mathematics classrooms has had a limited impact because teachers have not changed the way they teach mathematics with ICT but have just added an ICT dimension to their traditional practice. If teachers are willing to re-think their teaching and learning processes, seek new ways of integrating ICT to establish connections between the mathematics being learned and the lives of their students, then the potential to transform learning will be maximised. Learning environments which support this will necessarily be more student-centred, value deep understanding within a contextualised, collaborative, problem-solving setting where the control of the technology is shared with the students (Goos, Renshaw, Galbraith & Geiger, 2000; Kilderry, Yelland, Lazaridis & Dragicevic, 2003; Yelland & Kilderry, 2010).

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